

Varanus were met with, of which two are believed to be previously unrecognised. The remarkably ugly *Moloch horridus* was met with "in the open, during the day," throughout the expedition. The Snakes were not so numerous as the Lizards, but *Hornea pulchella*, a new genus and species of Elapidæ, was amongst the discoveries.

It would hardly be supposed that Central Australia would be a likely place for Amphibians, but wherever there were water-holes frogs were found in fair numbers, and Prof. Spencer gives us some very interesting remarks on them. Almost all of them belonged to two species—*Hyla rubella* and *Limnodynastes ornatus*. On visiting Charlotte Waters immediately after a heavy rainfall, Prof. Spencer found the "creeks and clay-pans swarming with frogs." As the waters dry up, the frogs disappear in their burrows, and remain hidden until rain comes again. Certain species of them (*Chiroleptes platycephalus* and others) gorge themselves with water before they go into their retreats, and in times of drought the natives dig them out and secure water enough from their bodies to satisfy thirst. Prof. Spencer gives a figure (Pl. xiv., Fig. 9) of a specimen of the above-named species with its "body swollen out with water."

As the frogs, so the fishes of the Eremian district hide themselves in the deeper water-holes, but they are not known to burrow. Examples of seven species were obtained, five of which, representing four genera, are new to science, and are described as such by Mr. Zietz.

Prof. Tate, one of the members of the expedition, himself describes the Mollusca. Before the advent of the party, the published information respecting the land-shells of this region was limited to three species, which number is now increased to twenty-five—nearly all of them new to science. The faunas of this part of the Fauna approximates rather to that of West Australia, than to any other part of the continent.

"The limited number of genera represented, together with the facts of their distribution, seem to indicate a primitive population which has been maintained in isolation by climatic and geological changes."

One genus (the Central-Australian Mollusca) was previously known only from New Caledonia. Mr. Hedley adds to Prof. Tate's article notes on the anatomical structure of some of the species.

For an account of the Crustacea of the Horn Expedition, we are again indebted to Prof. Spencer, who remarks that the rate of growth of some of the species must be very great. Not more than two weeks after rain had first fallen, and probably in only a few days, numberless specimens of an *Apus*, measuring from two to three inches in length, were swimming about in the water-holes, whereas before the rainfall not a single one could be found. Ten species of Crustacea in all were met with, *Estheria packardii* being the most widely distributed; whilst two (*Limnadopsis squirei* and *L. tatei*) are, so far as is yet known, confined to the central region.

We need not go deeply into the various groups of insects which are the subjects of most of the remaining pages of the volume. Butterflies are rare in Central

Australia, and examples of only five (already known) species were met with, and of moths specimens of only about fifteen species were captured. On the other hand, 800 specimens of Coleoptera, representing 145 species, were obtained, and of these sixty-two are new, and four of them belong to new genera. The Coleoptera were worked out by the Rev. T. Blackburn, of the South Australian Museum, except the Carabidæ, which Mr. Sloane undertook. Mr. J. G. O. Tepper informs us that the Orthoptera brought back by the expedition present few novelties, but that the knowledge acquired as to the distribution of the species is valuable. As regards the Formicidæ, a special essay is contributed by Mr. Froggatt on the Honey-ants. It is perhaps little known, except amongst professed entomologists, that certain species of this group have adopted the curious plan of "turning some of their fellows into animated honey-pots." Instead of placing honey in a comb as the busy bees do, the ants select a certain number of workers, and disgorge the honey obtained from the Eucalypti (on which it is deposited by Coccidæ and other insects) into the throats of their victims. The process being continually repeated, causes the stomachs of these workers to be distended to an enormous size. This extraordinary habit was first discovered in the case of certain ants in Mexico, and subsequently shown by Mr. M'Cook to prevail also in Colorado. It has been found to exist in Australia also, and Mr. Froggatt describes and figures three ants of the genus *Camponotus* that pursue this remarkable practice. The enormous size of the abdomen thus acquired by the unfortunate worker is shown in the central figure of Plate xxvii. These ants are a favourite food of the hungry native.

To sum up, we may repeat that this volume, which is well printed on good paper and excellently illustrated, does the greatest credit to Australia and to its enterprising citizens. They may well be pleased with Mr. Horn, who has not only planned and executed this important piece of work, but has also exerted himself so successfully on a point that is too often neglected in such undertakings—that is, on having the results thoroughly well worked out, and thus made known to science all over the world.

THE WATER SUPPLY OF NEW YORK.

The Water Supply of the City of New York, 1658–1895.

By Edward Wegmann, C.E. (New York: J. Wiley and Sons. London: Chapman and Hall, 1896.)

THIS work consists of a quarto volume of nearly 200 pages, with appendices and 148 plates, in addition to seventy-three figures in the text.

It was not until the year 1842 that the citizens of New York were able to celebrate the completion of their first water-works of importance. The works then constructed soon proved inadequate to the supply, and have had to be supplemented from time to time from other sources.

In view of the agitation which is now going on for improving the water supply of London, the particulars given in this book, of the various steps which have been taken for providing an adequate supply to the City of New York, are of considerable interest.

In 1875, the then source of supply being found in-

sufficient, the Department of Public Works submitted plans for new water-works. The reports on these plans were submitted by the Mayor to the Legislature. The Senate requested the Mayor to nominate five citizens who, in conjunction with himself, were to report on the best scheme to be adopted. After holding thirty-three public meetings, at which eminent engineers and citizens expressed their views with reference to the proposed works, a scheme was approved and adopted, the source of supply being the Croton River, from which the water hitherto in use has been obtained. They also advised that the works should be entrusted to "an unprejudiced Commission selected from the best citizens of the city." The Committee drew up a draft Bill embodying these recommendations, which formed the basis of "An Act to provide new reservoirs, dams, and a new aqueduct with the appurtenances thereto for the purpose of supplying the City of New York with an increased supply of pure and wholesome water," which was passed by the Legislature in 1883. An "Aqueduct Commission" was appointed, consisting of the Mayor, the Comptroller, the Commissioner of Public Works *ex officio*, and three citizens, the salary of each of the Commissioners being fixed at 8000 dollars (£1680) a year. The works carried out will be referred to later on.

The book under notice, which has been prepared by Mr. Wegmann, one of the engineers of the Water Commission, gives the history of the water-works of the City of New York from the sinking of the first public well in 1658 to the present time, and full technical details of the new works. This description cannot fail to be of interest to engineers engaged in water supply, and the great number of illustrations of the details of the construction, as showing the difference between English and American practice, are instructive, and may even give hints for the adoption of new methods of carrying out works of a similar character in this country.

Within about 300 years the population of New York has increased a thousand-fold, the number of inhabitants in 1664 being 1500, and now 1,515,301.

The first attempt at a public water supply was in 1658, when "the Burgomasters resolved to communicate with the Herr General relative to having a public well made in Heere Street," and subsequently six public wells were sunk. As the population increased, the well-water became polluted, and the inhabitants had to send to springs situated on the outskirts of the city for pure water. One of the most noted of these springs was known as the "Old Tea-water Pump," which is thus described in the diary of a traveller in 1748.

"There is no good water in the town itself, but at a little distance there is a large spring of good water, which the inhabitants take for their tea and for the uses of the kitchen. Those, however, who are less delicate on this point, make use of the water from the wells in the town, though it be very bad."

When the population had increased to 22,000, the Common Council of the city accepted a proposal of an English engineer, Christopher Colles, to construct a reservoir on Manhattan Island for supplying the city with water. The water was pumped up by one of Newcomen's atmospheric engines, and distributed through mains consisting of hollow logs. Owing, however, to

the insufficiency of the supply, and the confusion caused by the Revolution, this enterprise became abandoned. The next scheme for supplying the city with water was due to an Act of the Legislature, which, under the guise of incorporating a company for supplying the city with pure water, really was for the purpose of establishing the Manhattan Bank, the company being authorised by the Act to raise a large amount of capital, and employ it "in any other moneyed transactions or operations not inconsistent with the constitution and laws of the State." Only enough was done in introducing water to maintain the charter, the real object of the incorporation being the formation of the bank, to which there had been very strong opposition. For several years after this the water supply of the city remained in a very unsatisfactory state, and numerous schemes for providing a better supply were brought forward. From documents published in 1832 it appears that the quality of the water then used did not conduce to temperance, as one of the arguments used in favour of a new supply was: "By thus supplying the inhabitants with fine pure rock water, it will remove the popular pretext for using alcohol to correct the impurities of the water now in general use, and will be the most effectual means of promoting the great and noble cause of temperance in this city." The temperance cause seemed to occupy a considerable amount of public attention at this time, as in one of the contracts made for the construction of the new water-works was a clause to the effect that the contractor should not sell or allow to be sold any ardent spirits to their workmen, or to any person near the line of the works.

In 1834 an Act was passed forming a permanent Water Commission, and providing for the raising of £325,000 for constructing water-works. The Croton River was decided on as the source of supply. This river is situated thirty-three miles from the city. The water-shed above the dam has a ridge line of 101 miles, and an area of 532 square miles. Within this area are contained thirty-one natural lakes and ponds. The length of the river is thirty-nine miles, and its minimum flow above the dam 33,804,000 gallons. The average rainfall is 42.68 inches, the minimum being 38.52 inches.

The first, or "Fountain," reservoir was formed by constructing a dam across the river six miles above its mouth. The lake is four miles long, and has a width of about a quarter of a mile. Its area is 400 acres, and storage capacity 600 million gallons. The water was conveyed to the city by a masonry aqueduct a distance of thirty-three miles. The masonry conduit is 7 feet 6 inches in diameter with upright sides, and has an area of 53.34 feet. When the water was first admitted in 1842, a boat containing four persons was placed in the current, and arrived almost simultaneously with the water at the Harlem River, the velocity of the current being at the rate of one mile in forty minutes. The mean fall of the invert is at the rate of 0.6 feet per mile. The aqueduct is capable of discharging ninety-five million gallons in twenty-four hours. The distributing reservoir, situated three miles from the city, was constructed almost entirely above ground, by means of walls thirty-six to forty-nine feet above the surface. This reservoir is 420 feet square, and has a depth of water of thirty-six feet, the capacity being twenty-four million gallons. After the works became in

tull operation, no restriction being placed on the quantity used, the daily consumption amounted to seventy-eight gallons per head of the whole population, or ninety gallons for each water consumer.

From time to time the works have had to be enlarged and additional reservoirs built, until in 1875 it was determined to build a second aqueduct connected with a new reservoir to hold 1900 millions of gallons.

The new aqueduct, including a short length of pipe line, is thirty-four miles long, twenty-nine miles of which are in tunnel through gneiss rock. This aqueduct is lined throughout with masonry. The standard shape, where not under pressure, is of horseshoe section with a diameter of fourteen feet, the sectional area being equal to a circular masonry culvert having an internal diameter of fourteen feet. The available head is 33·70 feet, which is absorbed in overcoming friction through the conduit and pipes. The grade is at the rate of 0·7 feet per mile, and the velocity of the flowing water 3·27 feet per second. It is capable of discharging 300 millions of gallons in twenty-four hours.

The "Cornell" reservoir, now under construction, will contain when completed 32,000 million gallons. The central masonry dam is 600 feet long, with an earthen continuation of the same length. The maximum height of the masonry dam is 260 feet, the height above the river-bed being 159 feet, the top being 10 feet above the water-line. It is to be 18 feet wide at the top, and 185 feet at the base.

The total capacity of the conduits now supplying the city, which has a population at the present time of one and a half millions, is 425 millions of gallons. The total storage capacity of the reservoir is 75,000 millions of gallons, equal to a minimum supply in the driest years of 280 millions of gallons.

Mr. Wegmann's book is almost entirely of an historical and descriptive character, and is confined entirely to the works carried out for the water supply of New York. The details of these various works are, however, so copiously illustrated that they give the book an eminently practical character, which renders it of value to any engineer engaged in water-works construction.

A NEW CHEMICAL DICTIONARY.

A Dictionary of Chemical Solubilities. Inorganic. By Arthur Messinger Comey, Ph.D. Pp. xx + 515. (London: Macmillan and Co., Ltd., 1896.)

THIS is a book about which it is impossible to get up any feeling of enthusiasm; but one cannot resist a sense of wonder and admiration at the patient, plodding spirit in which the compiler must have set about his weary task, and carried it on through months or years of labour to the dreary end. Of course he is an American. In no other nation of the earth using or abusing the English tongue would a man have been found to undertake such an enterprise; but why the busy, rushing life of that great country across the Atlantic should breed so many compilers of catalogues and bibliographies and indexes, especially of physical science, of books which Charles Lamb would have called no books, *biblia a-biblia*,

it seems hard to say. The world ought to feel grateful to them, but usually it does not. It often uses such cyclopædias, though ready enough to grumble if it finds them less than perfect. In this volume the only smack of literary flavour is to be found in the preface, wherein the extract from "Peter Shaw's Chemical Lectures, publicly read at London in 1731 and 1732," shows that the plan of such a book was foreshadowed long before its accomplishment. For, according to the author, the first work that undertook to carry out the idea in its entirety was produced by Prof. F. H. Storer in 1864. All chemists are familiar with Storer's "First Outlines of a Dictionary of Solubilities of Chemical Substances," though long since out of print. It will at once be noticed that there is an important difference in the titles of the two works. Dr. Comey is, however, justified in using the expression "chemical solubilities," inasmuch as he does not confine his work to data concerning solutions in water and alcohol or other neutral solvents, but includes the action, for example, of acids upon metals, and the effects of various liquids, such as solutions of potash and aqueous acids. Moreover, certain physical facts are mentioned, such as changes of temperature on dilution, also any data obtainable regarding the boiling-points of solutions, and tables giving the specific gravities of aqueous solutions.

After all, the more modest title—"First Outlines"—adopted by Storer, seems to assume quite enough; for the materials for such a work amount at present to little more than a most miscellaneous collection of more or less inaccurate estimations of solubilities, without any clue as to the cause of solubility, and theories as to the condition of the dissolved substance still in conflict. This, however, has not deterred the compiler, who, on the whole, has done his work carefully and well. It would, perhaps, help the users—we can hardly speak of readers—of the Dictionary if in a future edition the general statements were somewhat amplified, and gathered together into an introductory chapter apart from the alphabetical array of details concerning particular cases. For example, it is obvious in regard to salts that the solubility in water is determined more by the nature of the negative radicle than of the metal. We can say truly that all nitrates are soluble in water except a few basic compounds, but we cannot predicate anything general concerning the solubility of the compounds, say, of lead. Some of these broad statements are given in the Dictionary, but they might be extended with advantage. A classification of the metals according to the action of water and of acids upon them might be given; it might also be worth while to state what is known of the colours of dissolved inorganic substances, concerning which there are some very curious facts which probably have an important significance could we only find the clue to their explanation.

From what has been said, it is obvious that this volume contains a mass of information brought together from a great variety of sources. It will certainly be found useful not only in the chemical laboratory, but also by the manufacturer and practical man to whom time is money. It may therefore be fairly described as one of those books which no chemist's library should be without.